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ABSTRACT

After a brief discussion of the position the Technion, Israel's institute of Technology and its only engineering school, occupies in the country and of Israeli high schools and the matriculation examination, this paper focuses on the successful and unsuccessful applicants to the Technion in the academic years 1967/68 and 1968/69. It discusses the differences in (1) grades on the matriculation certificate as well as the entrance exam, (2) place of birth, (3) ethnic origin, (4) socio-economic background, and (5) educational background. The successful applicant is generally a top student academically, from a small, middle-class family of Eastern European origin. (AF)

A PROFILE OF APPLICANTS TO A LEADING ENGINEERING SCHOOL*

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Technion - Israel Institute of Technology

* Paper presented at the 1971 Annual Meeting of the National Council on Measurement in Education, New York.

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Studies of college or university populations focus in general on the entering classes. Since many students apply consecutively to several institutes of higher learning, and since administration of student records is not centralized, it is difficult to ascertain which students have been admitted to one or other institution, and which were not accepted at any institution of higher learning. A better understanding of the "rejected" group is of special importance in view of the world-wide mounting pressure to enable students of different academic, educational and socio-economic backgrounds to study at institutes of higher learning. Moreover, such a study may provide educational and manpower planners with important information in considering the development and expansion of higher education. In Israel, the situation in which the Technion is the country's only engineering school, offers a unique opportunity to study these problems.

This is the third of a series of longitudinal prediction studies on engineering and science students in Israel focused only on those candidates who had been admitted (Perlberg 1965[1], 1967a[2], 1967b[3]). This study deals with the academic, educational and socio-economic profile of all applicants and the differentiating variables between the groups who had been admitted or rejected.

Before proceeding with the report, it would seem essential to provide the reader, who is not familiar with the Israeli educational system, with some background material about the Technion - Israel Institute of Technology (where the

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* Dr. A. Levy of Tel-Aviv University has advised on the statistical methods, Mr. N. Baharav, The Technion Secretary of Undergraduate Studies facilitated the collection of data. Mrs. Y. Rom collected the data and Mrs. R. Levin prepared the data for computation. We are indebted to all of them. The final analysis and interpretation of the data rests with the authors.

study took place), the Israeli high schools and the matriculation certificate*.

THE TECHNION - ISRAEL INSTITUTE OF TECHNOLOGY

The Technion is the only engineering school in Israel. Compared to engineering schools in the United States and Europe, it is considered to have rigorous standards. Admission to the Technion, as well as to other universities in Israel, requires a Matriculation Certificate. Selection is based on the combined average of competitive entrance examination and Matriculation Examination results. Since some departments cannot admit all candidates who have registered, the average score will also determine to which department the student will be admitted (he gives three priorities during registration). In other universities in Israel, three years are required to obtain a B.Sc. degree (which is accredited in the United States and other countries). At the Technion four years are required for a B.Sc.

During the first two years, the students of all departments study almost the same curricula. Most of the time is devoted to basic sciences and general engineering courses. A very small portion of the curriculum is devoted to general studies. It is assumed that general education has been acquired in the academic high school. Further, in a follow-up study on students in institutes of higher learning in Israel, Technion students had the highest mean grade on the Matriculation Certificate.

It is a highly select group and the persistence rate is high. Eighty to 85% of those entering the Technion graduate, and it is estimated that from those who have to leave, about half register in other universities or are graduated from engineering schools abroad. To be promoted from year to year in the Technion, a passing grade in each subject is not enough. The student has to achieve a required

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*For a more elaborate discussion see the bibliography.

general average. Those who do not achieve this average must repeat certain examinations, or the whole year, or leave the Technion.

THE HIGH SCHOOLS AND THE MATRICULATION EXAMINATION

Until recently, most Israeli high schools were mainly academic, college preparatory schools. The curriculum, methods of teaching, and evaluation were geared to the basic function of preparing students for the governmental matriculation examination, which entitles those who succeed to a Matriculation Certificate ("Teudat Bagrut"). This certificate is perceived by schools, parents, students and the public at large not only as a proficiency certificate which entitles its holder to proceed with his studies in universities, but also as an important status symbol and, in many instances, an employment requirement.

Most Israeli high schools, supervised by the Ministry of Education and Culture, are accredited. Graduates of accredited schools have, among other things, one important advantage over graduates of other schools. In determining the final grades of their student's Matriculation Certificate equal weight is given to the Matriculation Examination grade and the high school final grade. Although students from non-accredited schools as well as adults are eligible for the examination, no consideration is given to their high school grades. If high school grades given by a particular school are very high in comparison to examination grades, the school may be penalized and even lose its accreditation. However, if the difference is not more than one grade, the student will receive the higher grade. Each student is examined in six to eight subjects, according to areas of specialization which are organized into streams - science, biology, humanities, social science, vocational technical and agricultural.

PROCEDURES

The population studied is composed of 3,527 candidates who applied to the Technion for admission in the academic years 1967/68 and 1968/69. Matriculation

and entrance examination grades were obtained from Technion records. The biographical and socio-economic data was collected by means of questionnaries. The chi square test of significance was administered to verify statistically significant differences between the groups.

RESULTS* AND DISCUSSION

It has already been indicated that admission to the Technion is based on the combined average grade of the competitive Technion entrance examination and the government matriculation certificate grade. Table 1 gives the combined average grade and the grades in specific subjects of the Entrance Examination and the Matriculation Examination.

(INSERT TABLE 1)

Overall Differences

The data in Table 1 indicates that there is a significant statistical difference on all grades for those admitted and those rejected. It will be noted that the differences in the Technion entrance examination grades, were greater than those of the matriculation certificate grades. It appears that the main differentiating factor is the entrance examination, but the difference of grades in the matriculation certificate is still small and the group of applicants as a whole is relatively homogeneous.

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*This is only a selected list of results. A more detailed report will be published in Israel during 1971.

TABLE 1

COMBINED AVERAGE GRADES AND GRADES ACCORDING TO SUBJECTS FOR THE TECHNION ENTRANCE EXAMINATION AND THE MATRICULATION CERTIFICATE*

		ADMITTED		REJECTED	
	YEAR	$\bar{X}$	SD	$\bar{X}$	SD
Combined Average Grade	1967	73	1.04	58	1.69
	1968	75	0.92	66	1.48
Entrance Examination					
Average Grade	1967	70	1.21	52	1.87
	1968	72	1.51	56	1.80
Mathematics	1967	72	1.32	54	2.03
	1968	72	1.72	53	1.92
Physics	1967	68	1.42	50	1.95
	1968	73	1.79	59	2.06
Matriculation Certificate					
Average Grade	1967	74	0.65	69	3.41
	1968	74	0.76	69	2.49
Hebrew	1967	69	0.79	66	0.69
	1968	68	0.79	65	0.68
Bible	1967	71	0.90	66	0.85
	1968	70	0.92	67	0.87
Foreign Language	1967	68	0.94	64	0.98
	1968	68	1.00	63	0.92
Mathematics	1967	76	1.04	69	1.16
	1968	76	1.08	69	1.13
Physics	1967	75	0.97	69	1.01
	1968	75	1.00	70	0.97

* All results are significant at the 0.01 level.

The fact has important implications for the on-going discussion in Israel* about the need for, and feasibility of expanding the Technion's capacity to enrol more students, or whether additional engineering schools should be established. The question has been raised as to whether there is a sufficient reservoir of qualified candidates for such schools. In a previous study, Chen et al.(1966)[4] indicate that the average matriculation certificate grade of Technion students was the highest for all students admitted to institutes of higher learning in Israel. Since the differences between the rejected and accepted groups, as shown in Table 1,are not very high, it is logical to assume that many of them could become suitable engineering and science candidates.

Differences in Particular Subjects

Average grades in scientific subjects (mathematics and physics) are significantly higher than those obtained in "humanistic" subjects (e.g. Hebrew language and literature, Bible studies, and foreign languages, usually English). The majority of applicants, and especially those admitted to the Technion, are usually drawn from the science stream of college preparatory high schools. Even though there is no published data to substantiate the following generalization, it is commonly agreed by high school and university teachers as well as by students, that the majority of the brightest students in the high school population, most of them males, are found in the science stream, while the humanities and social science streams attract the less able students. This seems to result in a low estimation of humanistic studies, particularly by science students, many of whom disregard poor achievements and grades in these subjects.

In previous studies, Perlberg (1965[1], 1967a[2], 1967b[3]) found that high school grades in the humanities were somewhat better predictors of achievement for the

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*Patenkin, D. (Chairman) A Report by the Committee Examining the Need to Expand Engineering Education In Israel, Jerusalem, 1970 (in Hebrew).

last two years of Technion studies. One explanation of this is that the population is already selective and relatively homogeneous in regard to ability and to high school achievement in science or in vocational-technical courses. Moreover, it becomes even more homogeneous after the attrition in the first two years of study at the Technion. It would therefore seem that in the later years at engineering school, when the student is confronted with projects, problem solving processes and decision making, a good general educational background may differentiate the weak from the strong.

The problem should, however, not only be confined to how good the student's chance of graduating from the Technion is. To a certain degree the character and make-up of our future engineers and scientists is at stake. Being aware of the need to "bridge the cultures", Technion students have been required, in recent years, to attend a weekly two-hour course of humanistic studies. However, here again these courses are held in low regard by many of the students, and are viewed as a nuisance.

The problem of teaching humanities and social studies to science and engineering students, both at high school and college cannot be dealt with in this paper, but it should be most strongly emphasized that it has far-reaching implications for the development of science and technology in our society. Curriculum developers, teaching methodologists and psychologists need to give special attention to the problem of how to teach humanistic and social science studies to highly intelligent students, whose numerical aptitudes are likely to be greater than their verbal skills, but would still be able to cope adequately with other areas of knowledge were they offered more attractively, and as a challenge to their overall intellectual and analytic ability.

NON ACADEMIC VARIABLES

Place of Birth

About 50% of the applicants were born in Israel, and of those born abroad the majority had immigrated before 1954, thus receiving their elementary and secondary education in Israel. About 13% of the immigrants had been educated in other countries and this number was significantly higher in the rejected group. Relatively few immigrants of university age have either aspired to, or tried to enrol at the Technion because of language difficulties or because their academic standards failed to meet Technion requirements. It is only recently that the number of immigrants at institutes of higher learning has increased, following the effort made by the government and the universities to help them to study and thereby encourage them to settle in Israel. At the Technion their number is still relatively small. The present system of selection favours the above-average student who has been educated mainly in Israel.

The Ethnic Profile of Technion Applicants

The problems arising from the diversity of Jewish ethnic groups in Israel, and certain of its manifestations in the educational system, especially in higher education, have been discussed elsewhere by Perlberg and Rom (1968)[5]. It should, however, be stated briefly that there exist acute problems due to cultural, educational and economic gaps between the Israeli "old timers" - immigrants from European and Western countries who are referred to as Ashkenazi Jews, and immigrants from the Islamic countries (i.e. the Middle East, North Africa and Asia) who are referred to as Sephardic Jews.*

Sephardic Jews constitute about 50% of the total population and their children

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*Sephardic Jews may also come from Balkan countries (Bulgaria, Greece, and Turkey) and the term is also used to include Yemenite Jews. The word Sephardic is from "Sepharad" (Spain) and refers to those Jewish people whose ancestors lived in Spain, Southern France, and Italy during the Middle Ages.

account for about 60% of the school-age population. However, afterelementary school their enrolment declines sharply to 25% at secondary school level and about 15% at university level. This phenomenon has far-reaching social implications and many efforts are being made to change it.

Table 2 describes the ethnic profile of Technion applicants. The data refers to the father's place of birth. Since many applicants were born in Israel, it would otherwise not have been possible to verify how many were of Sephardic origin, according to their place of birth.

TABLE 2

THE ETHNIC PROFILE OF TECHNION STUDENTS FOR BOTH ADMITTED AND REJECTED GROUPS AS INFERRED FROM DATA ON FATHER'S PLACE OF BIRTH

Father's Place of Birth	ADMITTED				REJECTED			
	N*		%		N*		%	
	1967	1968	1967	1968	1967	1968	1967	1968
Israel **	28	61	4.2	6.5	44	54	6.8	6.1
Middle East, Africa and Asia ***	100	139	14.8	14.8	87	150	13.4	17.2
Eastern Europe	495	676	74.1	72.1	463	616	71.6	70.1
Western Countries****	45	62	6.9	6.6	53	59	8.2	6.6
TOTAL	668	938	100.0	100.0	647	879	100.0	100.0

* In certain cases information was obtained for only 80% of the subjects.

** Among the Israeli born, there are also some Sephardic Jews who share the problems discussed.

*** Including Sephardic parents who immigrated from Balkan countries.

**** Western countries including Western Europe and the English-speaking countries.

From Table 2 it will be seen that the great majority of Technion applicants are Ashkenazi in origin, the children of parents who immigrated from Eastern Europe. Only 15% of the applicants are of Sephardic origin. Admitted and rejected groups show the same ethnic profile. However, additional analysis shows that the percentage of those of Sephardic origin who were rejected would have been larger, had it not been for the special preparatory program for soldiers of Sephardic origin established at the Technion and at the Hebrew University several years ago (Perlberg and Rom, 1968)[5]. The percentage of all applicants admitted was about 50%, while the percentage of soldiers of Sephardic origin who had attended the special program and had been admitted was 80%. The number of students of Sephardic origin at the Technion is still very small and not proportional to their number in the general population. Special programs to increase their number have been relatively successful and there is a need for greater effort in this direction.

The Socio-Economic Profile

Eighty five percent of the applicants to the Technion come from small families - with 1 to 3 children. Such families constitute only 53% of the Jewish population. On the other hand, only 5.6% came from families with five or more children, the family size in 26% of the population. In 1967 there was no significant difference in this variable between the admitted and rejected groups. In 1968, the number of "only children" was greater in the admitted than in the rejected group.

About 75% of the applicants' fathers are salaried employees, or independent merchants, artisans and professionals. The economic background of applicants could therefore be classified as middle class. The number of fathers who had had university education is relatively small - between 12 and 16%. The majority of applicants are usually the first- or second-born in immigrant families from Eastern Europe, the members of which had no higher education but who were doing their best to motivate and support their children to obtain professional education. This is the first generation to obtain higher education in such families. There was no significant

difference in this variable for the rejected and admitted groups.

Educational Background

The majority of applicants to the Technion come from the science stream of academic high schools, vocational-technical schools and from among students who had taken an external matriculation examination. A very small percentage come from the humanistic or biological streams, from agricultural schools or high schools abroad.

There are significant differences in the applicants' educational background between the admitted and rejected groups. Those admitted included a greater number of graduates from the science streams of academic high schools than from vocational technical schools, or from among external matriculation students. By comparison, the number of graduates from vocational-technical schools and external matriculation examinations was significantly greater in the rejected group.

TABLE 3

ADMITTED AND REJECTED APPLICANTS ANALYSED
ACCORDING TO TYPE OF SCHOOL-LEAVING CERTIFICATE

	ADMITTED				REJECTED			
	N		%		N		%	
High School	1967	1968	1967	1968	1967	1968	1967	1968
Academic (Total)	492	602	69.8	63.6	425	374	48.5	42.4
Science	408	481	57.9	50.8	296	250	33.8	28.3
Humanities	28	53	4.0	5.6	64	66	7.3	7.5
Biology	56	68	7.9	7.2	65	58	7.4	6.6
Vocational-Technical and Agricultural	151	184	21.5	19.5	288	281	32.9	31.8
External Examination	48	108	6.7	11.3	144	140	16.5	15.9
Schools Abroad	14	53	2.0	5.6	18	87	2.1	9.9
TOTAL	705	947	100.0	100.0	875	882	100.0	100.0

Planning to Study at the Technion

The majority of Technion applicants claimed that they had decided to study at the Technion as far back as the upper elementary or lower high school years. This variable shows a significant difference between the groups. The number of those who had decided to study at the Technion at a relatively early age was higher among those admitted than those rejected. Moreover, the early choice of area of specialization was also a differentiating factor. It appears that early professional socialization has a strong motivational effect, and increases a student's chance of being admitted. Only a small number of applicants admitted any outside influence by parents, teachers, etc.

When applicants were asked what they would do if rejected, the number of those who answered that they would try again, was higher among those admitted than those rejected and, of those who had been rejected, the greater number indicated that they would try to enrol in engineering schools in other countries. Here again, highly-motivated and determined students had greater chances of being admitted.

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